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MEASUREMENT OF ECHO ENERGY SPLITTING OF HIGH RESOLUTION SONAR T--ETC(U)
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TECHNICAL NOTE

MEASUREMENT OF ECHO ENERGY SPLITTING OF HIGH RESOLUTION SONAR TRANSMISSIONS (U)

Submitted to

U. S. Naval Undersea Warfare Center
San Diego, California 92152

Attention: Code D551

8 March 1968

SCIENCES AND SYSTEMS DIVISION • SAN DIEGO LABORATORY

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Approved:

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ABSTRACT

This report describes the technique used to measure the extent of echo energy splitting as a result of multiple arrivals of a returning sonar transmission. Graphs of a typical correlogram obtained from correlation of the returned signal, and the plot of density function of the measurements of energy splitting are included.

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MEASUREMENT OF ECHO ENERGY SPLITTING USING HIGH RESOLUTION TRANSMISSIONS

(C) Recent availability of high resolution sonar data consisting of 1000 Hz bandwidth LFM and PRN transmissions of up to 5 second duration has enabled the extension of echo energy splitting investigation beyond previous studies. This report covers only a portion of the available data with more extensive investigations to follow. The specific portion of data analyzed used a one second, 1000 Hz, LFM transmission with the array in the bottom bounce mode at a forty degree depression angle.

(C) From previous studies it has been determined that echo energy splitting accounts for a significant amount of performance degradation in sonar applications using large time-bandwidth product transmissions.

(C) TRACOR document number TRACOR SD-67-023 (U), "Measurement of Echo Energy Splitting", describes a technique of measuring the extent of echo energy splitting for a high resolution sonar system. As described in the referenced document, the ratio of signal energy in the highest resolvable peak of the echo to the signal energy in the total echo arrival gives the desired measure of energy splitting.

(C) This technique has been applied to the VERULAM data on a limited basis. Thirty seven bottom bounce echoes resulting from 1000 Hz bandwidth, 1 second duration LFM transmissions were processed through a linear, quadature correlator. A typical correlogram of the analyzed data appears in Figure A-1.

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As evidenced by the correlogram, the echo shows a highly structured splitting with the one millisecond resolution fairly obvious.

(C) Measurements of energy splitting were made on each of the correlograms referenced above. Results were obtained ranging from -5.8 dB to -11.3 dB. The mean echo energy splitting was calculated to be -8.7 dB. Further investigation has revealed that deficiencies in the transmit beamformer resulted in approximately 3 dB of energy splitting of the transmitted signal at this depression angle. With the results (measured in dB) plotted on a probability grid, as in Figure A-2, two interesting aspects of the examination appear. Within the accuracy of the tests, the calculated mean is in agreement with the mean at the 50% probability axis of the graph and the form of the results obtained follow a normal law.

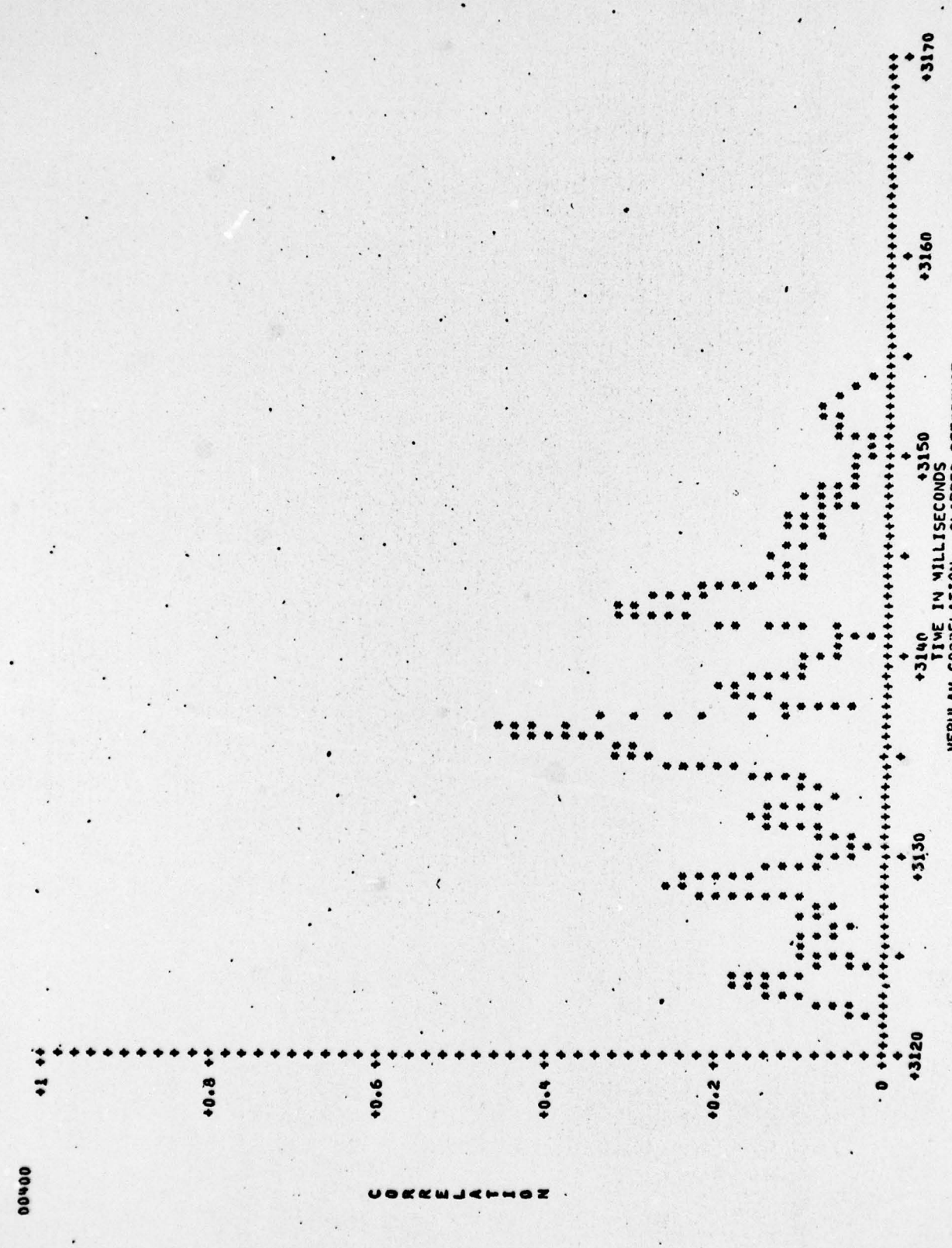

Figure A-1

CORRELOGRAM FOR A 1000 Hz, 1 SEC, LFM ECHO

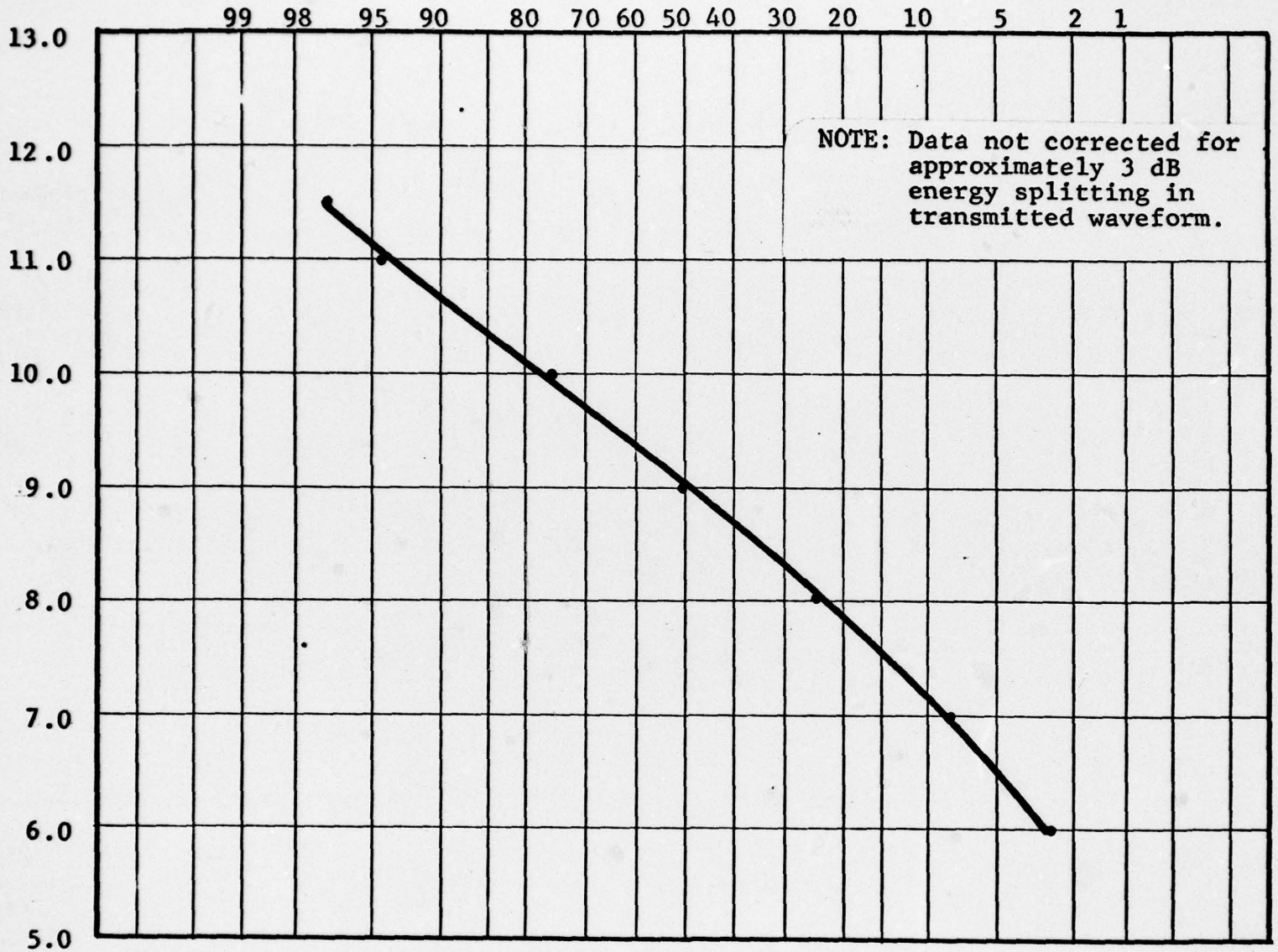

FIGURE A-2 DENSITY FUNCTION OF ECHO ENERGY SPLITTING MEASUREMENTS